

A new species of the enigmatic shrimp genus *Pseudosquilla* (Decapoda: Bresiliidae) from Sulawesi (Indonesia), with the designation of a new family Pseudosquillidae.

Sammy De Grave and M. Kasim Moosa

Abstract.— A new species of caridean shrimp, *Pseudosquilla neutra* sp.nov. is described from Sulawesi, Indonesia. The new species can be distinguished from its congeners by a suite of characters, including the presence of a distinct tooth on the posterolateral margin of the fifth pleuron, as well as several differences in spination. A new family, Pseudosquillidae is created to accommodate the genus. This family can be distinguished from the Bresiliidae and Alvinocarididae in the presence of well developed exopods on the ambulatory pereopods and the fusion of the ischium and merus of the first and second pereopods, and from the Disciadidae primarily in the absence of a disc-shaped dactylus of the first pereopod. The new family differs from all known Caridean families in the presence of pseudosquillate ambulatory pereopods.

Introduction

The genus *Pseudosquilla* was erected by Chace & Brown (1978) to accommodate a peculiar shrimp, *Pseudosquilla enigma* from the Great Barrier Reef. This taxon differed from all known caridean shrimps, by having pseudosquillae on the ambulatory pereopods, with all other carideans (except Procarididae) being characterised by one, or usually two, anterior pairs of chelate pereopods. A further species, *Pseudosquilla chacei* Kensley was established by Kensley (1983) for specimens from Florida and Belize. Both species

are only known from their respective type series.

The present contribution reports on further specimens from this rare genus from the Tukangbesi Archipelago in south-eastern Sulawesi (Indonesia), validating the prediction by Kensley (1983) that additional species may be found between the two presently known localities. As the specimens could not be confidently attributed to either species, a new species is described to accommodate them. Further, a new family is erected to accommodate the genus. The holotype will be deposited in the collections of the Bogor Museum, Indonesia, whilst the paratype is in the collections of the Royal Belgian Institute of Natural Sciences (KBIN).

Taxonomy

Genus *Pseudosquilla* Chace & Brown, 1978

Pseudosquilla neutra, new species
(Figs. 1–4)

Material examined.— Male holotype, post-orbital carapace length (pocl) 1.70 mm; Kaledupa Reef, Kaledupa, Tukangbesi Archipelago, south-eastern Sulawesi, Indonesia; from coral rubble collection, -10 m deep, leg. S. De Grave, 11/07/2000 (field sample number 62); ovigerous female paratype (rostrum damaged) pocl 0.70 mm, KBIN IG.30003; Kaledupa Reef, Kaledupa, Tukangbesi Archipelago, south-eastern Sulawesi, Indonesia; from coral rubble collection, -10 m deep, leg. S. De Grave, 12/07/2000 (field sample number 72).

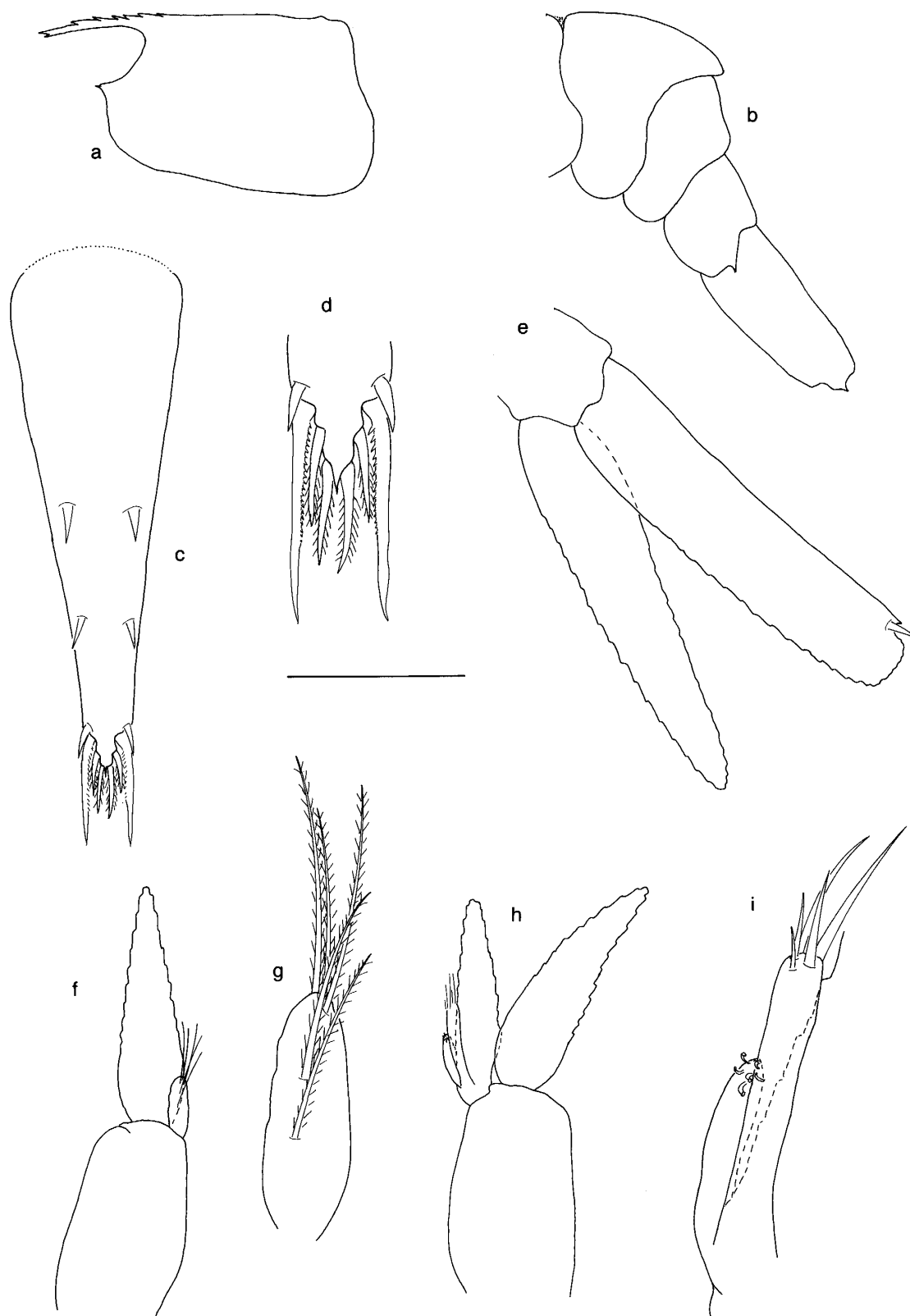


Fig. 1. *Pseudocheles neutra*, new species; a-b, f-i from male holotype, remainder from female paratypes (KBIN IG.30003). a, carapace; b, pleonites 3-6; c, telson; d, tip of telson; e, uropod; f, pleopod 1; g, endopod of pleopod 1; h, pleopod 2; i, appendices interna and masculina. Scale bar indicates 1.5 mm (a-b), 0.5 mm (c, e, f, h), 0.25 mm (d) or 0.12 mm (g, i).

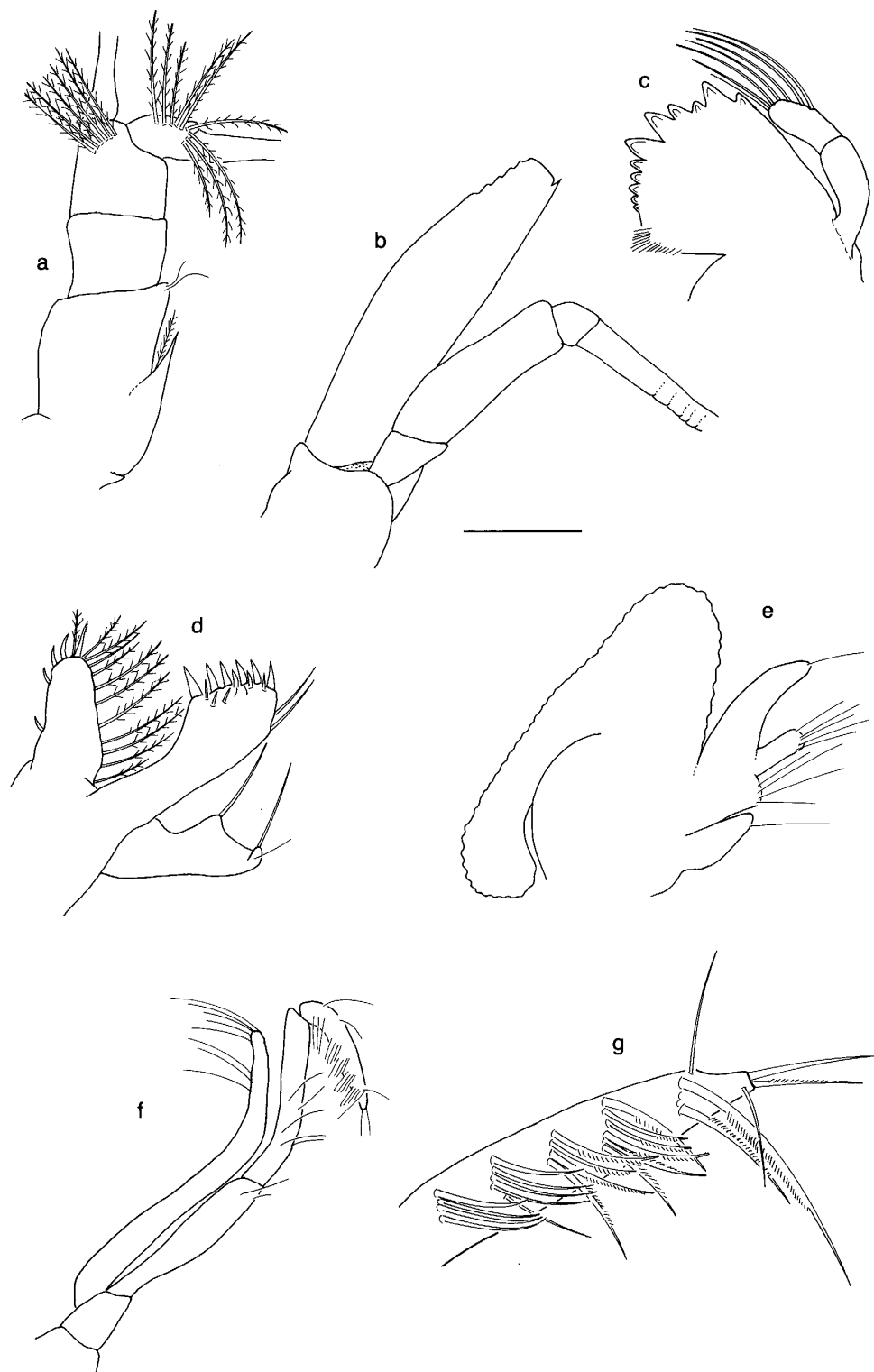


Fig. 2. *Pseudocheles neutra*, new species, female paratype (KBIN IG.30003). a, antennular peduncle; b, scaphocerite and antennal peduncle; c, left mandible; d, maxillule; e, maxilla; f, third maxilliped; g, tip of third maxilliped. Scale bar indicates 0.4 mm (a-b), 0.2 mm (c-f) or 0.1 mm (g).

Description.— Rostrum slender (Fig. 1a), nearly reaching to distal margin of second segment of antennular peduncle; dorsal-

ly armed with 6 near equidistant teeth, one of which is situated post-orbitally; ventrally armed with subapical, single tooth. Carapace

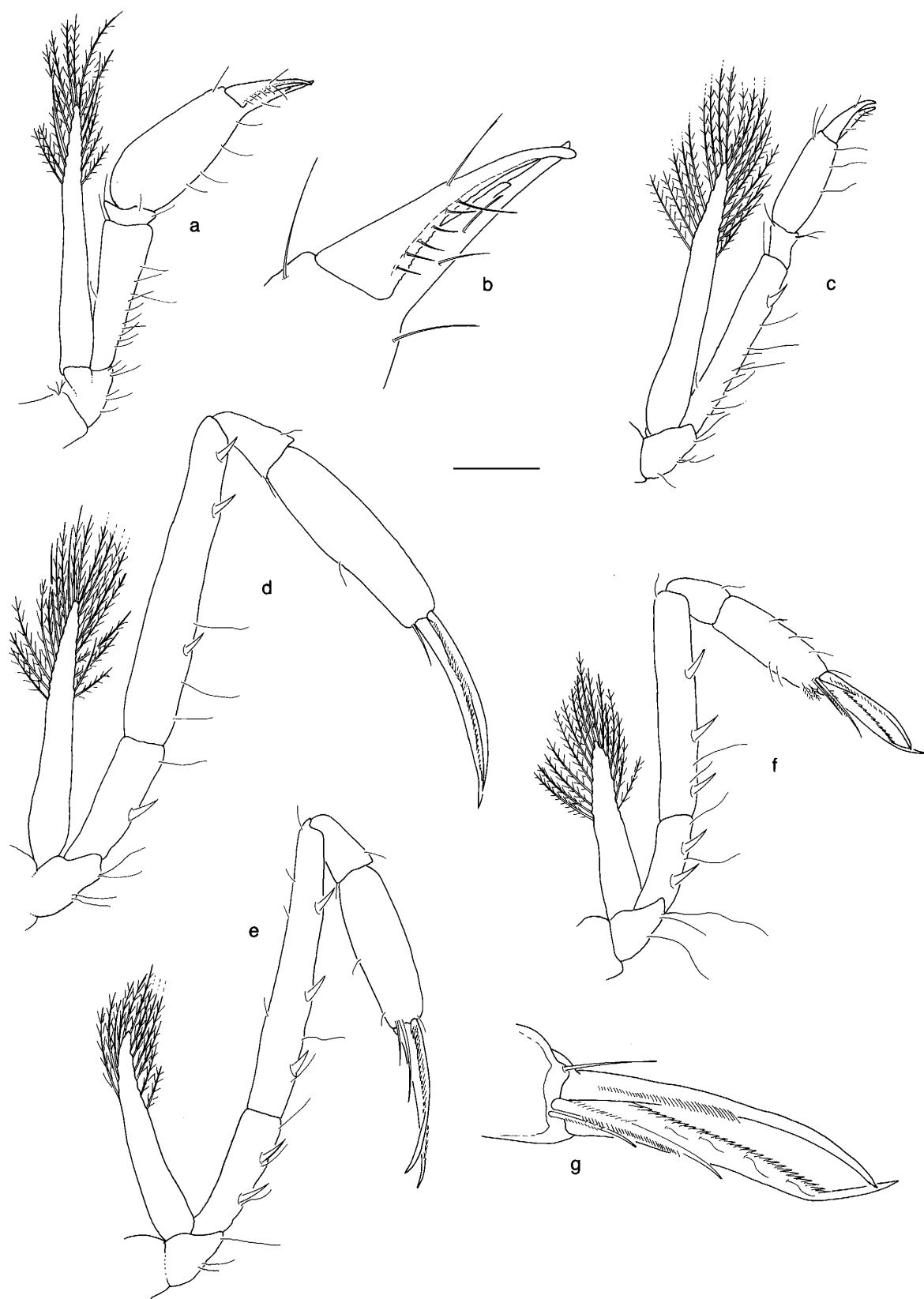


Fig. 3. *Pseudocheles neutra*, new species, female paratype (KBIN IG.30003). a, first pereopod; b, tip of chelae of first pereopod; c, second pereopod; d, third pereopod; e, fourth pereopod; f, fifth pereopod; g, dactylus of fifth pereopod. Scale bar indicates 0.4 mm (a, c-f) or 0.12 mm (b, g).

with low denticle in posterior 0.88 of dorsal margin; antennal spine (Fig. 1a) small but distinct, arising just ventral to broadly rounded orbital lobe. Thoracic sternites unarmed.

Abdomen (Fig. 1b) with third somite projecting as low cap over anterior part of fourth somite; pleuron of fourth somite posteroventral angle slightly angular, pleuron of fifth somite posteroventrally rounded with strong tooth on posterolateral margin; sixth somite 1.1 times length of telson, posteroventral angle angular, posterolateral margin produced into a sharp tooth.

Telson (Fig. 1c) 3.2 times as long as anterior width, armed with three pairs of dorso-lateral spines, anterior-most pair situated at 0.5 of telson length, median pair situated at 0.75; posterior-most pair overreaching bases of lateral pair of posterior spines; posterior margin subtriangular (Fig. 1d), indented, tip with sharp median point; three pairs of posterior spines; lateral pair longest, sinuous, inner margin denticulate in proximal half; intermediate and medial pair subequal in length, distal two-thirds plumose.

Uropods slightly shorter than telson, endopod and exopod subequal in length (Fig. 1e), strap-like; exopod with movable spine mesial to distolateral tooth; spine slightly overreaching distal margin of exopod.

Antennular peduncle (Fig. 2a) reaching to distal third of scaphocerite; stylocerite tapering to acute tip, reaching to distal third of basal peduncle segment; latter approximately twice as long as second segment; third segment slightly longer than second; dorsolateral flagellum approximately 2.3 times as long as carapace; ventromesial flagellum shorter.

Antenna with basicerite bluntly produced ventro-laterally; scaphocerite (Fig. 2b) approximately 3.8 times as long as wide, narrower in distal third; distolateral tooth small, just overreaching distal margin; antennal flagellum approximately 3.9 as long as carapace. Epistome without anteriorly directed process.

Mandible (Fig. 2c) with two-segmented palp, incisor process broad, with 11 teeth; molar process small, lobe-like, not distinctly separated from incisor, bearing row of short setae. Maxillule (Fig. 2d) with proximal endite distally rounded, bearing 11 plumose setae along inner margin, outer margin with few spines; distal endite armed with row of distal and subdistal spines on mesial margin; palp bifurcate, single simple seta on each bifurcation. Maxilla (Fig. 2e) with two endites; proximal endite single lobe; distal endite bilobed, proximal lobe reduced; palp with single distal seta; scaphognathite broad, not over-reaching palp. First and second maxilliped lost during dissection. Third maxilliped (Fig. 2f) slender, 5-segmented (ischium and merus fused); distal segment bearing 5 rows of serrate setae; tip furnished one serrate and one simple seta; exopod nearly reaching distal margin of penultimate segment.

First pereopod (Fig. 3a) short, reaching to distal margin of basal antennular peduncle segment; fingers slightly less than half length of palm, distally curved, tips crossing when flexed; dactylus obscurely dentate in proximal half, fixed finger with truncated spine in distal third (Fig. 3b); carpus very short, recessed in distal meral hollow; ischium and merus fused; exopod nearly reaching to midlength of palm.

Second pereopod (Fig. 3c) slightly overreaching first pereopod; more slender than first; fingers slightly more than half length of palm; cutting edges both with series of spines; dactylus overreaching tip of fixed finger; ischiomerus with single spine in distal quarter of flexor margin; exopod reaching to midlength of palm.

Third to fifth pereopod with curved dactyli opposing a subequally long, serrate, spiniform seta, resembling pincers (Fig. 3g). Third pereopod (Fig. 3d) longest, overreaching scaphocerite by half of propodus plus chela; dactylus subequal to propodus in length, with row of spines along proximal three-quarters; propodus distally with spiniform seta, opposing dactylus; propodus 2.8

times as long as carpus; merus 1.5 times as long as propodus, furnished with three spines along flexor margin; ischium short, with single spine on flexor margin; no spinose process on basis; exopod reaching to half length of merus. Fourth pereopod (Fig. 3e) and fifth pereopod (Fig. 3f) similar to third; propodus proportionally shorter; three near equidistant spines along flexor margin of merus; ischium with two spines on flexor margin, no spinose process on basis.

First pleopod of male (Fig. 1f) with endopod reduced, 0.24 times length of exopod, endopod distally slightly tapering, approximately 2.82 times as long as wide (Fig. 1g), with 3 plumose setae along mesial margin (broken off during dissection, insertion points still visible), and 5 plumose setae in medial row, extending to tip. Second pleopod of male (Fig. 1h) furnished with appendices interna and masculina; appendix masculina (Fig. 1i) reaching to 0.5 of length of endopod, tip furnished with 5 simple spiniform setae of varying length; appendix interna reaching 0.73 of appendix masculina, tip with six cincinnuli.

Derivation of name.— The specific name is derived from the Latin *neuter*, meaning neither one nor the other, in reference to it being distinct from either of the two previously described species.

Habitat.— Both specimens were collected from loose, unconsolidated rubble, which also harboured specimens of *Alpheus collumianus* Stimpson, *Synalpheus* cf. *gracilirostris* De Man and *Thalassocaris crinita* (Dana). Although the rubble samples contained examples of encrusting sponges, ascidians, hydroids and bryozoans, no specific associations were observed.

Remarks.— *Pseudoscheles neutra* new species can be distinguished from its congeners on the basis of a number of characters. *Pseudoscheles enigma* does not possess a pleural tooth on the fifth abdominal segment, a character present in *P. neutra* new species. Further differences are in the strongly developed antennal spine in *P. enigma* (versus minute in *P. neutra* new

species), the presence of a pair of dorsal setae on the telson tip in *P. enigma* (versus none in *P. neutra* new species), as well as differences in spination of the merus, ischium and carpus of the ambulatory pereopods in both species. Although *P. enigma* new species shares with *P. chacei* the possession of a pleural tooth on the fifth abdominal somite and a minute antennal spine, both species can be distinguished by the absence of a spiniform process on the basis of the third and fourth pereopods in *P. neutra* (versus present in *P. chacei*), a differently shaped stylocerite (tapering to an acute tip in *P. neutra* versus with a distinct shoulder in *P. chacei*) as well as differences in spination of the merus, ischium and carpus of the ambulatory pereopods in both species. *P. neutra* differs from both species in the absence of a spine on the flexor margin of the carpus of the ambulatory pereopods

Discussion

Although the species of the genus *Pseudoscheles* are very distinct and relatively unique amongst carideans, in view of their pseudochelate ambulatory pereopods, their familial assignment amongst the bresilioid families remains problematic. In 1977, Forest (1977) discussed the then known genera and maintained the separation of the family Bresiliidae Calman, containing the single genus *Bresilia* Calman and the Disciadidae Rathbun, containing the genera *Discias* Rathbun and *Lucaya* Chace. However, Chace & Brown (1978) noted intermediate character states of *Pseudoscheles* and synonymised both families. This morphologically disparate concept of the Bresiliidae was further enlarged with the discovery of several deep-sea vent or seep taxa, such as *Alvinocaris* Williams & Chace, and others. Christoffersen (1986) applied a cladistic analysis to the bresilioid genera (which he placed in the Atyoidea, rather than a separate superfamily) and once again separated the families Bresiliidae and Disciadidae, whilst also establishing the fam-

ily Alvinocarididae and maintained the Agostocarididae as a distinct family in 1990 (Christoffersen, 1990). This concept was taken further by Vereshchaka (1997), who recognised three families and added a fourth one, Mirocarididae (since synonymised with Alvinocarididae by Komai & Segonzac, 2003), but included *Agostocaris* in the Bresiliidae, a move not followed by other authors. This historical confusion has resulted in some authors following Christoffersen (1986) and Vereshchaka (1997) in recognising 3-4 families (e.g. Komai & Segonzac, 2003), whilst other authors have maintained the Bresiliidae *sensu lato* (e.g. Martin & Hessler, 1990; Williams & Dobbs, 1995). Komai & Segonzac (2003) recently re-diagnosed the family Alvinocarididae, with its monophyletic status appearing to be supported by a suite of synapomorphies. Although this has reduced the morphological disparity in the remaining bresilioid clade, problems still remain with the classification of the other genera into two separate families, Bresiliidae *sensu stricto* and Disciadidae. As *Pseudochelodes* occupies an intermediate morphological position between Bresiliidae *sensu stricto* and the disciadid genera (for a full discussion of this, see Chace & Brown, 1978), either a more inclusive Bresiliidae *sensu lato* family concept needs to be once again supported, or *Pseudochelodes* needs to be placed into its own monogeneric family. As *Bresilia* itself is quite clearly closely allied to the Alvinocarididae (Williams & Chace, 1982; Bruce, 1990), the return to a Bresiliidae *sensu lato* family concept would jeopardise the continued recognition of the Alvinocarididae, therefore we suggest the removal of *Pseudochelodes* from the Disciadidae *sensu* Christoffersen (1986) and Vereshchaka (1997), and the establishment of a new family, Pseudochelidae to accommodate it. Disciadidae *sensu stricto* is thus restricted to *Discias*, *Tridiscias* and *Lucaya*. Two other genera are difficult to place in either family: *Encantada* Wicksten and *Kirnasia* Burukovsky. Bruce (1990) is fol-

lowed in regarding *Encantada* as closely related to *Bresilia*, and as such is placed in the Bresiliidae *sensu stricto*; *Kirnasia* remains *incertae sedis*, as the description is based on juvenile specimens (see Vereshchaka, 1997), although Bruce (1990) placed it in the disciadid clade.

Family Pseudochelidae, new family

Differential diagnosis.— Carapace with antennal spine, no other spines present. Thoracic sternites unarmed. Telson posteriorly with triangular endpiece, with three pairs of lateral spines. Mandible with two-segmented palp, indistinctly divided into molar and incisor, molar obsolescent. First and second pereopods with ischium and merus fused; first pereopod more robust than second; carpus partially recessed into merus. Chelae not provided with disc-shaped dactylus. Third to fifth pereopods chelate (or pseudochelate). Exopods well developed on all pereopods.

Composition.— Monogeneric, containing *Pseudochelodes* Chace and Brown, 1978; with three species (*Pseudochelodes enigma* Chace and Brown, 1978; *Pseudochelodes chacei* Kensley, 1983; *Pseudochelodes neutra* new species)

Remarks.— Christoffersen (1986) separated *Bresilia* (and thus Bresiliidae) from a clade containing *Psalidopus* Wood-Mason and Alcock, *Pseudochelodes*, *Lucaya*, *Tridiscias* Kensley and *Discias*, on the basis of a single apomorphy, the ischium and merus of the first and second pereopods not being fused in *Bresilia*, versus fused in the other genera. *Psalidopus* was separated from the remaining genera (united in the Disciadidae) on the basis of several unique synapomorphies for *Psalidopus*, and the presence of a bilobed epipod on the second maxilliped in the remaining genera. As *Psalidopus* has usually been placed in its own superfamily, Psalidopodoidea, rather than amongst the Atyoidea (see Chace, 1992), its autapomorphies should bear no relevance to the bresilioid-disciadid separation. Vereshchaka

(1997) provided a short diagnosis of both families, noting the only difference being that Bresiliidae (containing the genera *Bresilia* and *Agostocaris*) have exopods on the first two pereopods only, versus Disciadidae (*Discias*, *Lucaya*, *Tridiscias*, *Pseudochelès*) harbouring exopods on all pereopods. Further, Disciadidae was diagnosed as having a "dactylus in pereopods 1-2 semicircular and compressed", a character which clearly does not apply to *Pseudochelès*. Komai & Segonzac (2003) in their rediagnosis of Alvinocarididae mentioned one further character as potentially useful in separating both families, the second maxilliped being six-segmented in Disciadidae versus seven-segmented in Bresiliidae). The latter character is probably not of familial significance, as *Bresilia antipodarum* Bruce and *Bresilia plumifera* Bruce, also have a six-segmented second maxilliped, due to the fusion of the basis and ischium (Bruce, 1990). *Pseudochelès* (and hence Pseudochelidae) differs from the Disciadidae primarily in the development of the chelae of the first pereopods, which in all Disciadidae consists of a disc-shaped dactylus, although slightly reduced in *Lucaya*. In contrast, the chelae of *Pseudochelès* are more mainstream caridean-like, with a relatively unspecialized carpus. It differs further in the form of the endites of the maxilla and the form of the third maxilliped (see Chace & Brown, 1978). Members of Pseudochelidae differ from Bresiliidae primarily in the presence of well developed exopods on the ambulatory pereopods and the fusion of the ischium and merus of the first and second pereopods. Both these families differ further from each other in the presence of ornately armed thoracic sternites in Bresiliidae versus unarmed in Pseudochelidae. A further difference between the three families lies in the structure of the mandible, which is distinctly bifurcate with a well developed molar process in both Disciadidae and Bresiliidae (and Alvinocarididae), but with a poorly developed molar process in Pseudochelidae. Pseudochelidae differs from all other bresil-

loid families, in the presence of pseudochelate ambulatory pereopods, a character of unknown evolutionary and ecological significance, but one which remains unique amongst the Caridea.

Acknowledgements

Dr. T. Coles is acknowledged for the invitation to carry out fieldwork in Hoga, which was made possible by the assistance of staff and student volunteers of Operation Wallacea. Prof. K. Wouters (KBIN, Brussels) procured additional financial support, whilst Dr. T. Komai (Chiba) and Dr. A.J. Bruce (Brisbane) are acknowledged for a critical reading of an earlier version of the manuscript.

Literature Cited

- Bruce, A. J., 1990. Two deep-sea shrimps new to the Australian fauna, *Psathyrocaris hawaiiensis* Rathbun (Pasiphaeidae) and *Bresilia antipodarum*, sp. nov. (Bresiliidae), with remarks on *Encantada spiniculata* Wicksten (Bresiliidae). *Invertebrate Taxonomy*, 4: 847-866.
- Chace, F. A. Jr., 1992. On the classification of the Caridea (Decapoda). *Crustaceana*, 63: 70-80.
- , & Brown, D.E., 1978. A new polychelate shrimp from the Great Barrier Reef of Australia and its bearing on the family Bresiliidae (Crustacea: Decapoda: Caridea). *Proceedings of the Biological Society of Washington*, 91: 756-766.
- Christoffersen, M. L., 1986. Phylogenetic relationships between Oplophoridae, Atyidae, Pasiphaeidae, Alvinocarididae fam. n., Bresiliidae, Psalidopodidae and Disciadidae (Crustacea Caridea Atyoidea). *Boletim de Zoologia, Universidade de Sao Paulo*, 10: 273-281.
- , 1990. A new superfamily classification of the Caridea (Crustacea: Pleocyamata) based on phylogenetic pattern. *Zeitschrift für Zoologische Systematik und Evolutionsforschung*, 28: 94-106.
- Forest, J., 1977. Un groupement injustifié: la superfamille des Bresilioidea. Remarques critiques sur les statuts des familles réunies sous ce nom (Crustacea Decapoda Caridea). *Bulletin de Muséum National d'Histoire Naturelle*, (3) 475, Zoologie 332: 869-888.

- Kensley, B., 1983. New records of bresiliid shrimp from Australia, South Africa, Caribbean, and Gulf of Mexico (Decapoda: Natantia: Caridea). *Smithsonian Contributions to Zoology*, 394: 1–31.
- Komai, T., & Segonzac, M. 2003. Review of the hydrothermal vent shrimp genus *Mirocaris*, redescription of *M. fortunata* and reassessment of the taxonomic status of the family Alvinocarididae (Crustacea: Decapoda: Caridea). *Cahiers de Biologie Marine*, 44: 199–215.
- Martin, J. W. & Hessler, R. R., 1990. *Chorocaris vandoverae*, a new genus and species of hydrothermal vent shrimp (Crustacea, Decapoda, Bresiliidae). *Contributions in Science*, 417: 1–11.
- Vereshchaka, A. L., 1997. A new family for deep-sea caridean shrimp from North Atlantic hydrothermal vent. *Journal of the Marine Biological Association of the United Kingdom*, 77: 425–438.
- Williams, A. B., & Chace, F. A. Jr., 1982. A new caridean shrimp of the family Bresiliidae from thermal vents of the Galapagos rift. *Journal of Crustacean Biology*, 2: 136–147.
- , & Dobbs, F. C., 1995. A new genus and species of caridean shrimp (Crustacea: Decapoda: Bresiliidae) from hydrothermal vents on Loihi Seamount, Hawaii. *Proceedings of the Biological Society of Washington*, 108: 228–237.

Addresses: (SDG) Oxford University Museum of Natural History, Parks Road, Oxford OX1 3PW, U.K; (MKM) Pusat Penelitian dan Pengembangan Oseanologi, PO Box 4801 JKTF, Jakarta 1048, Indonesia.

E-mails: (SDG) sammy.degrave@oum.ox.ac.uk; (MKM) coremap@indosat.net.id.